University of Twente

Dance Movement Patterns Recognition (Part II)

Jesús Sánchez Morales

University of Twente
The Netherlands

University of Twente
The Netherlands

Contents

- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Contents

- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Goals

- Recognizing simple user's movements
- Recognizing complex patterns
- Auto generation of reference patterns
- Pattern searching during the dance without any reference

Contents

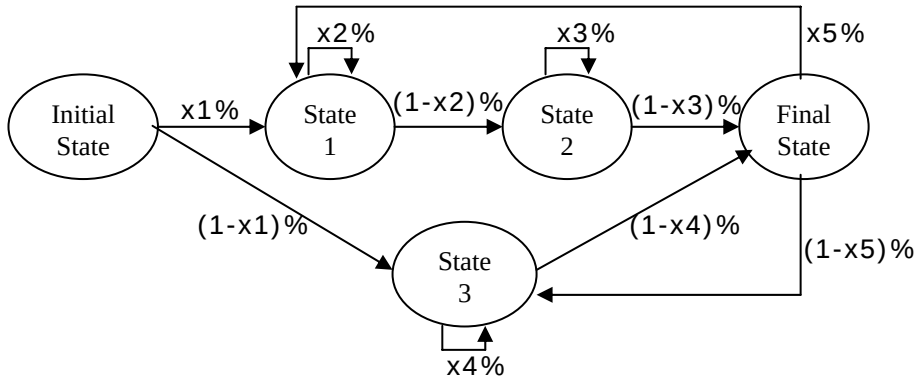
- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Hidden Markov Model (HMM)

- Highly used in Speech Recognition
- We adapted it for our problem
- Data sequences to analyze

Stop	move 1	move 2	stop

- HMM graphs for each recognition
- Viterbi's algorithm



University of Twente
The Netherlands

Contents

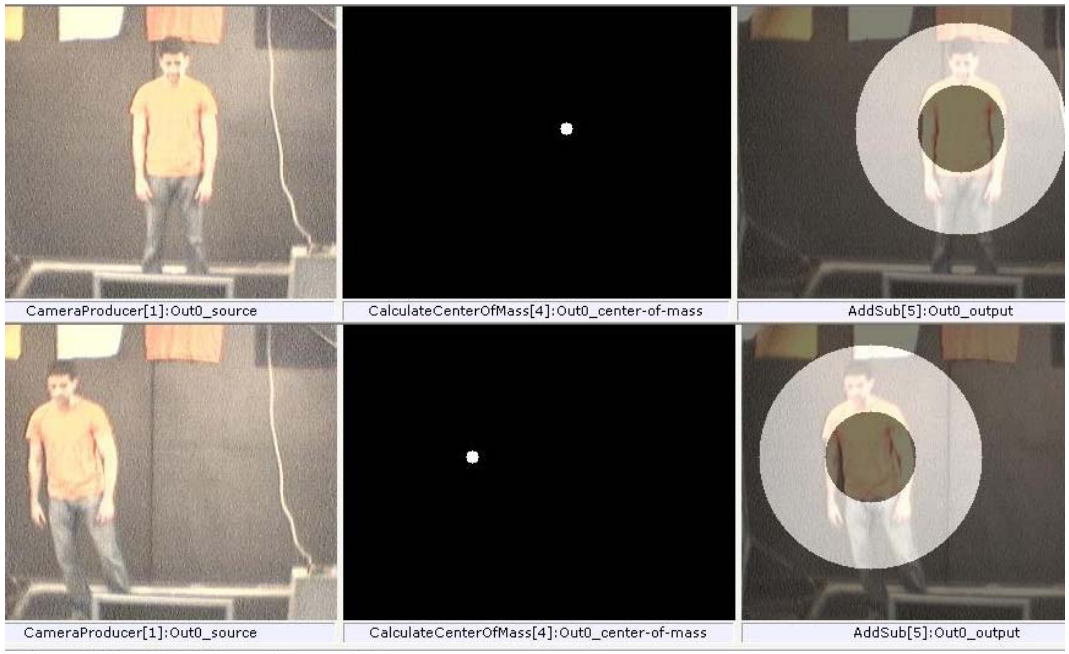
- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Recognizing Simple Steps

- What we understand as being a simple step?
  - Right, left, down, up, jump and twister
- How we divided these recognitions
  - Horizontal
  - Vertical
  - Twister

Recognizing simple steps (Horizontal)

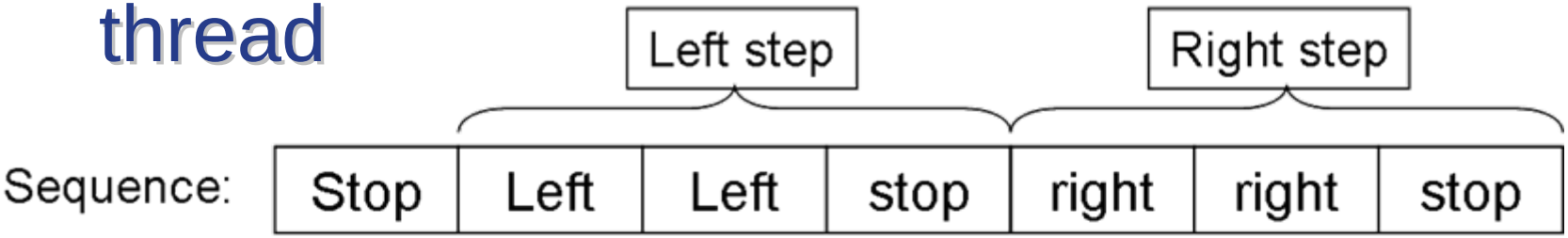
- Recognized steps
  - Left step
  - Right step



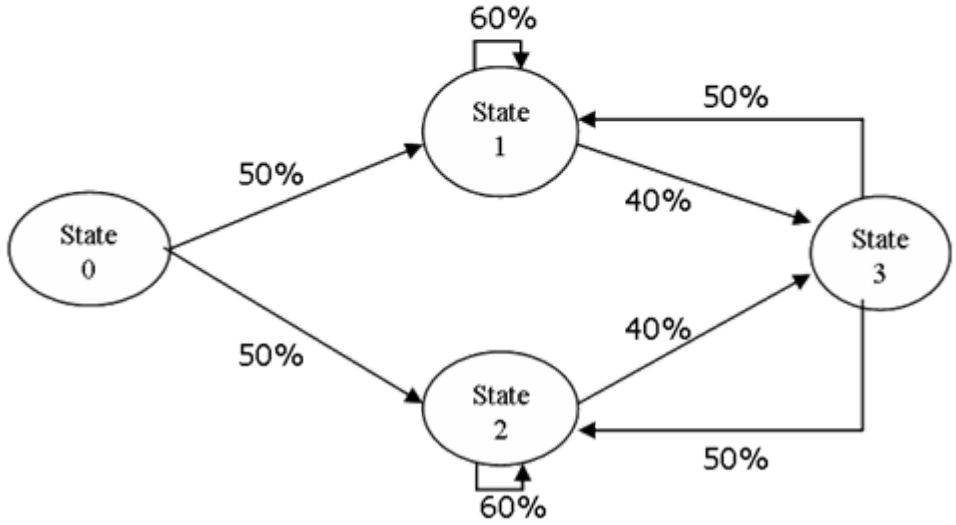
- Used data
  - Horizonal variation of the centre of mass between frames
  - User radius

Recognizing simple steps (Horizontal)

- Building a sequence and launching a thread

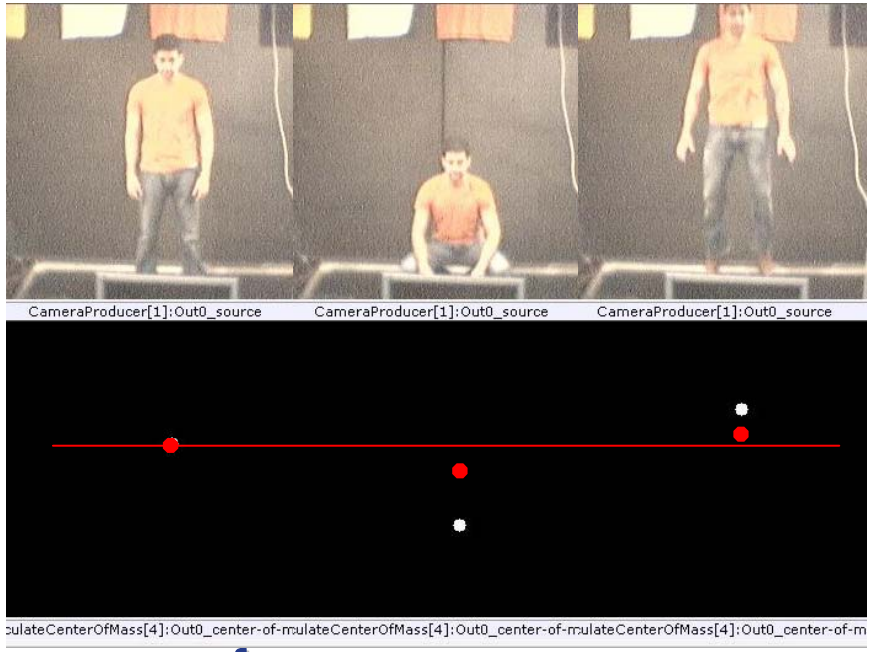


- Markov graph



Recognizing simple steps (Vertical)

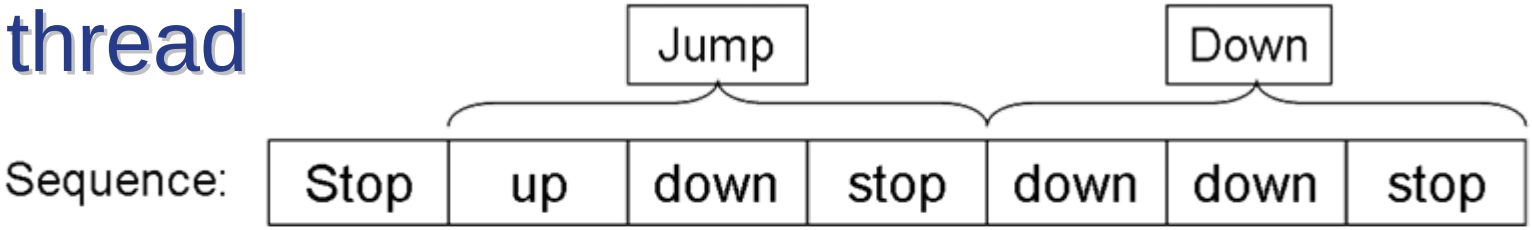
- Recognized steps
  - Up
  - Down
  - Jump



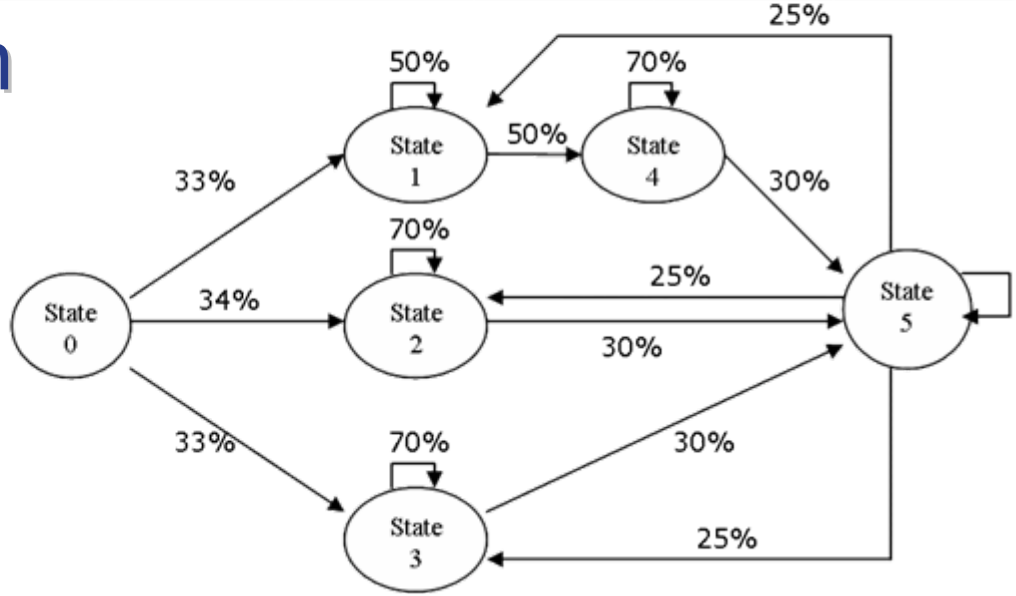
- Used data
  - Vertical position of the centre of mass
  - Vertical average position of the centre of mass
  - User radius

Recognizing simple steps (Vertical)

- Building a sequence and launching a thread

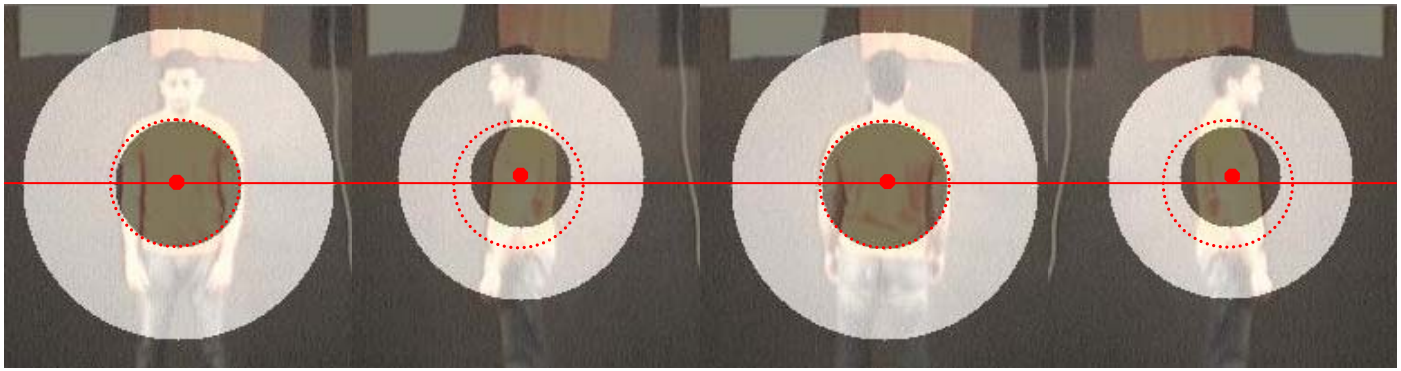


- Markov graph



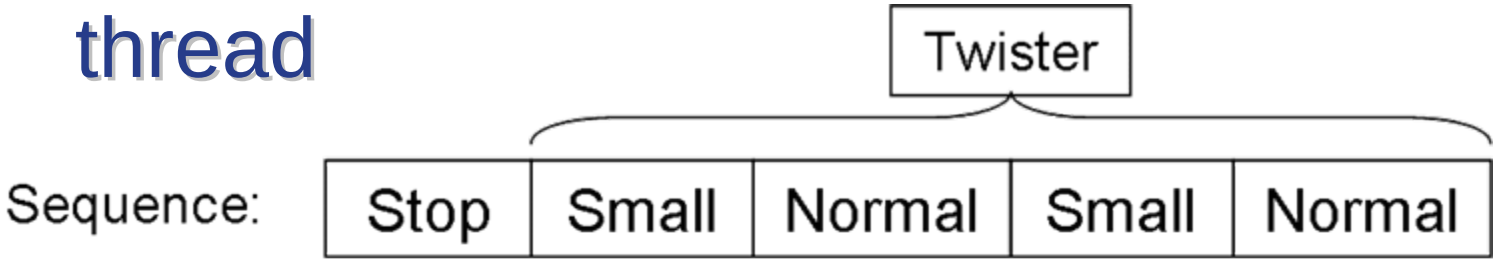
Recognizing simple steps (Twister)

- Recognized steps
  - Twister
- Used data
  - User radius
  - Average radius
  - Horizontal and vertical position of the centre of mass

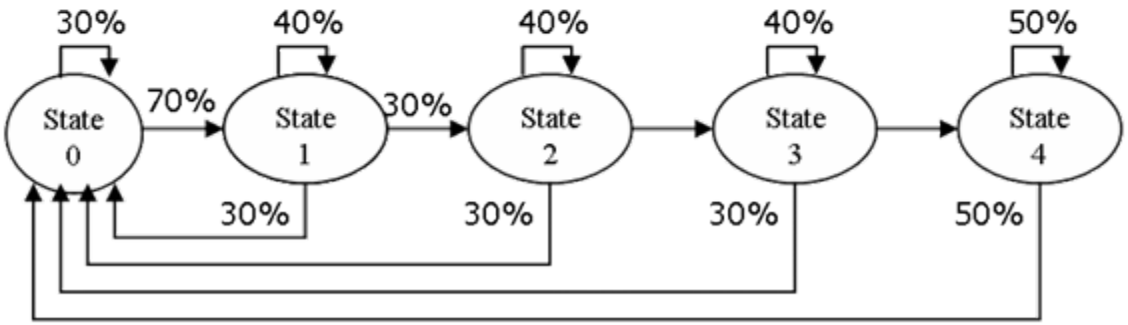


Recognizing simple steps (Twister)

- Building a sequence and launching a thread



- Markov graph



Contents

- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Recognizing Complex Patterns

- What we understand as being complex pattern?
  - Combinations of simple steps

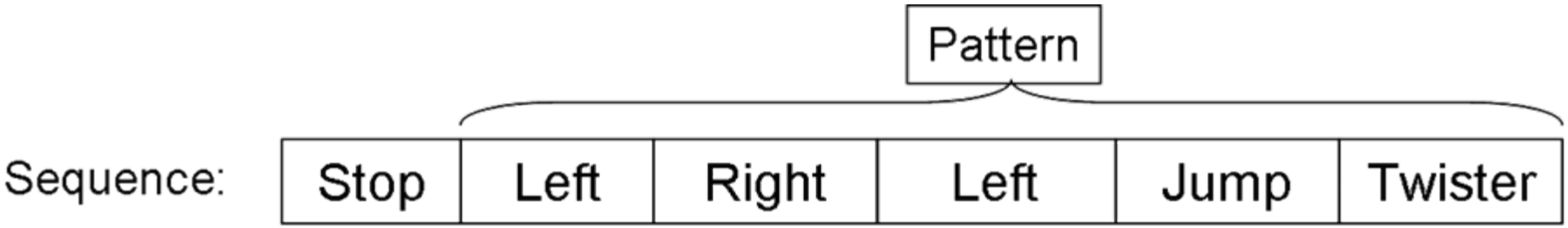
    Left Step + Right Step + Left Step + Jump + Twister +…

- What we receive from the simple step recognition
  - Step code
  - Duration
  - Step time

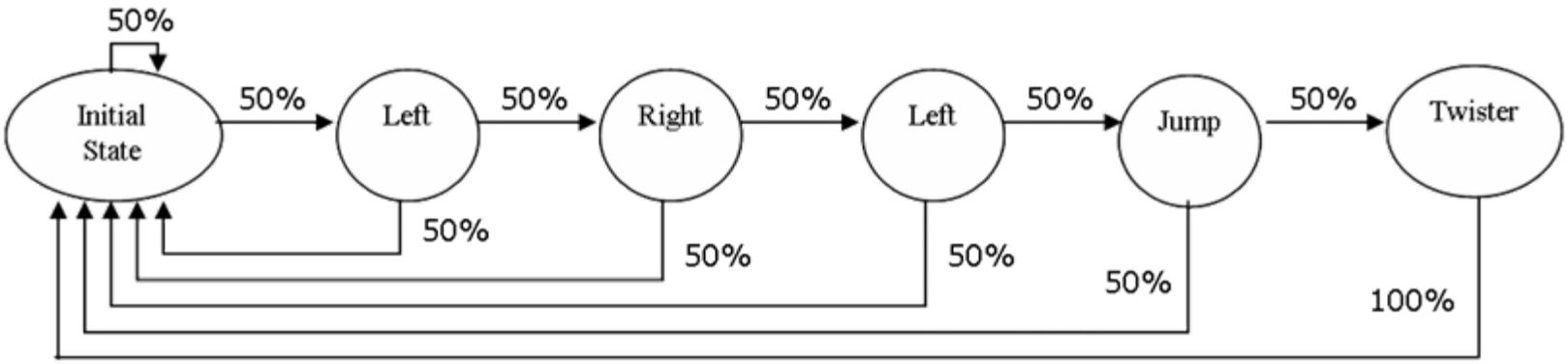
Left Step
Code: 11
Duration: 3 frames
Time: second 54

Recognizing Complex Patterns

- Building a sequence and launching a thread



- Markov Graph



Contents

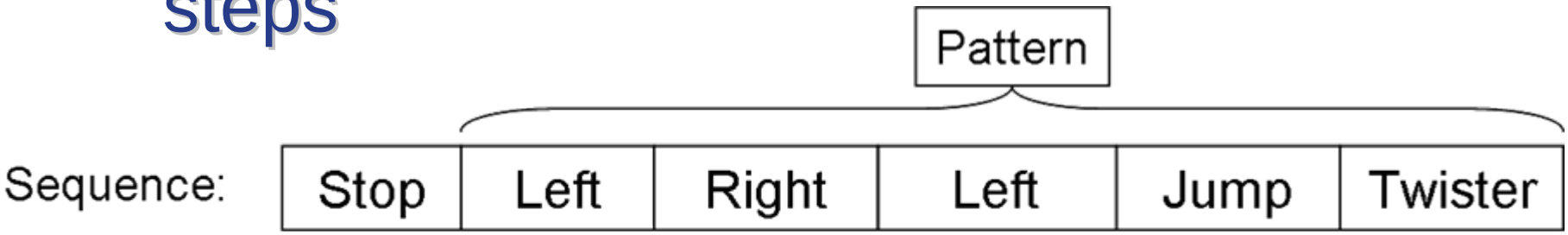
- Goals
- HMM
- To Recognize Simple Steps
- To Recognize Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Auto Generation of Complex Patterns Graphs

- Easy way of building graphs for complex patterns recognition
- Included in the pattern recognition
- Saved as a text file

Auto Generation of Complex Patterns Graphs

- We receive the sequence of simple steps



- We build the graph for the recognition

Contents

- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Test Bench

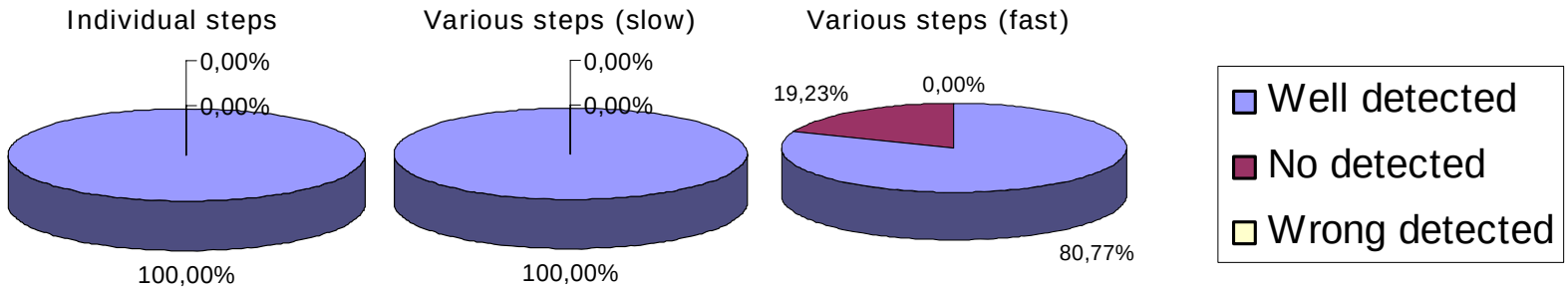
- Test setup
  - Good external conditions
  - Real time tests - 210 steps
  - Possible results for each test
    - Well detected
    - Wrong detected
    - Not detected

Test Bench

- Test organization
  - Horizontal recognition
  - Vertical recognition
  - Twister recognition
  - Complex pattern recognition

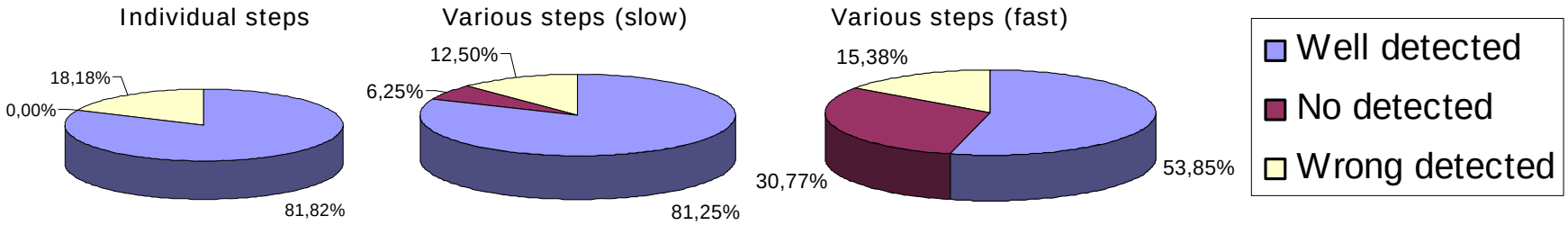
Test Bench (Horizontal recognition)

- High success rate
- No wrong detections
- In case of fast dance some steps get lost



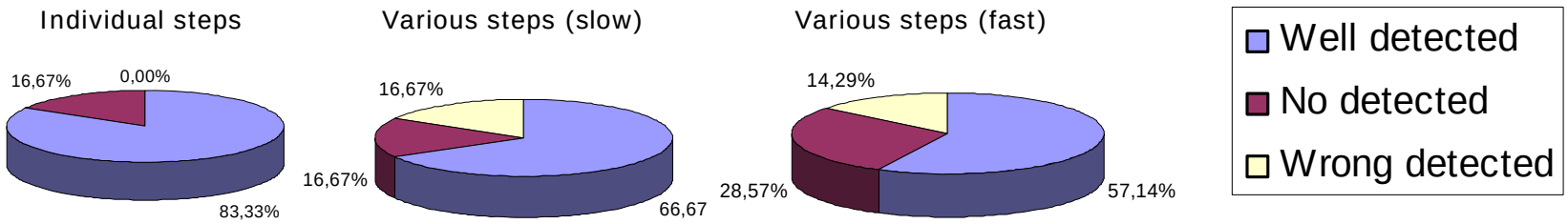
Test Bench (Vertical recognition)

- Very good individual step recognition
- Slow dance tests: some recognition problems
- Fast dance tests: recognition performance decreases



Test Bench (Twister recognition)

- High recognition performance for steps separately taken
- Slow dance tests: start having major detection problems
- Fast dance tests: many steps are mixed



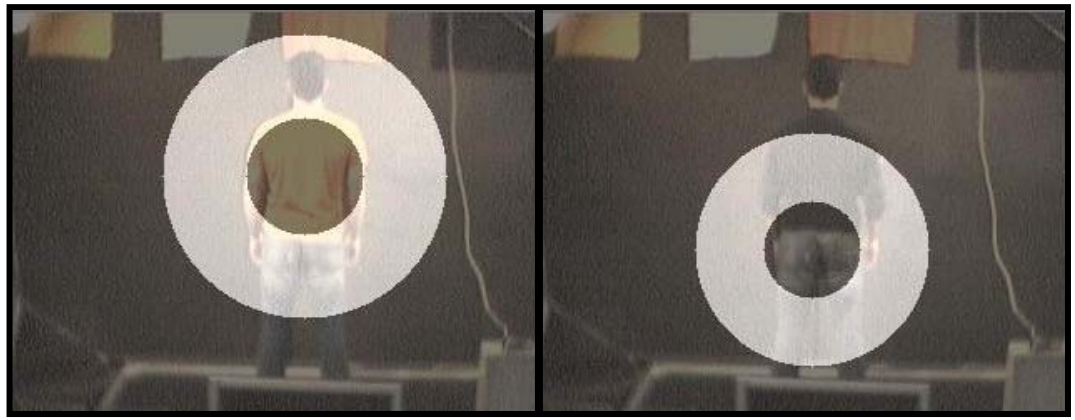
Test Bench (Complex pattern)

- Perfect recognition performance for steps separately taken
- No concrete pattern to analyze
- Inherit problems
  - Wrong simple step recognition
  - Too slow simple step recognition
  - Wrong received order

Contents

- Goals
- HMM
- Recognizing Simple Steps
- Recognizing Complex Patterns
- Auto Generation of Complex Patterns Graphs
- Test Bench
- Conclusions

Conclusions (Difficulties encountered)



- Clothe variations
- Unknown frame rate
- Similarities in the vertical movements
- User radius variation due to arms movements
- Failed complex pattern recognition due to wrong order in simple movements recognition

Conclusions (Possible improvements)

- Visual detection
- Use of the data from the “dance dance revolution pad”
- Relating the beat detector with the user recognized steps
- Detection of other simple movements
- Development of a learning algorithm to improve the HMM graphs

Conclusions (Reached goals)

- We have found a good technique to recognize body movements
- In some cases the results have not been as good as we hoped but we think that can be improved
- This technique is also valid to detect more complex patterns
- We easily generate complex pattern graphs
- It has not been possible to search patterns without reference

Thank you very much !